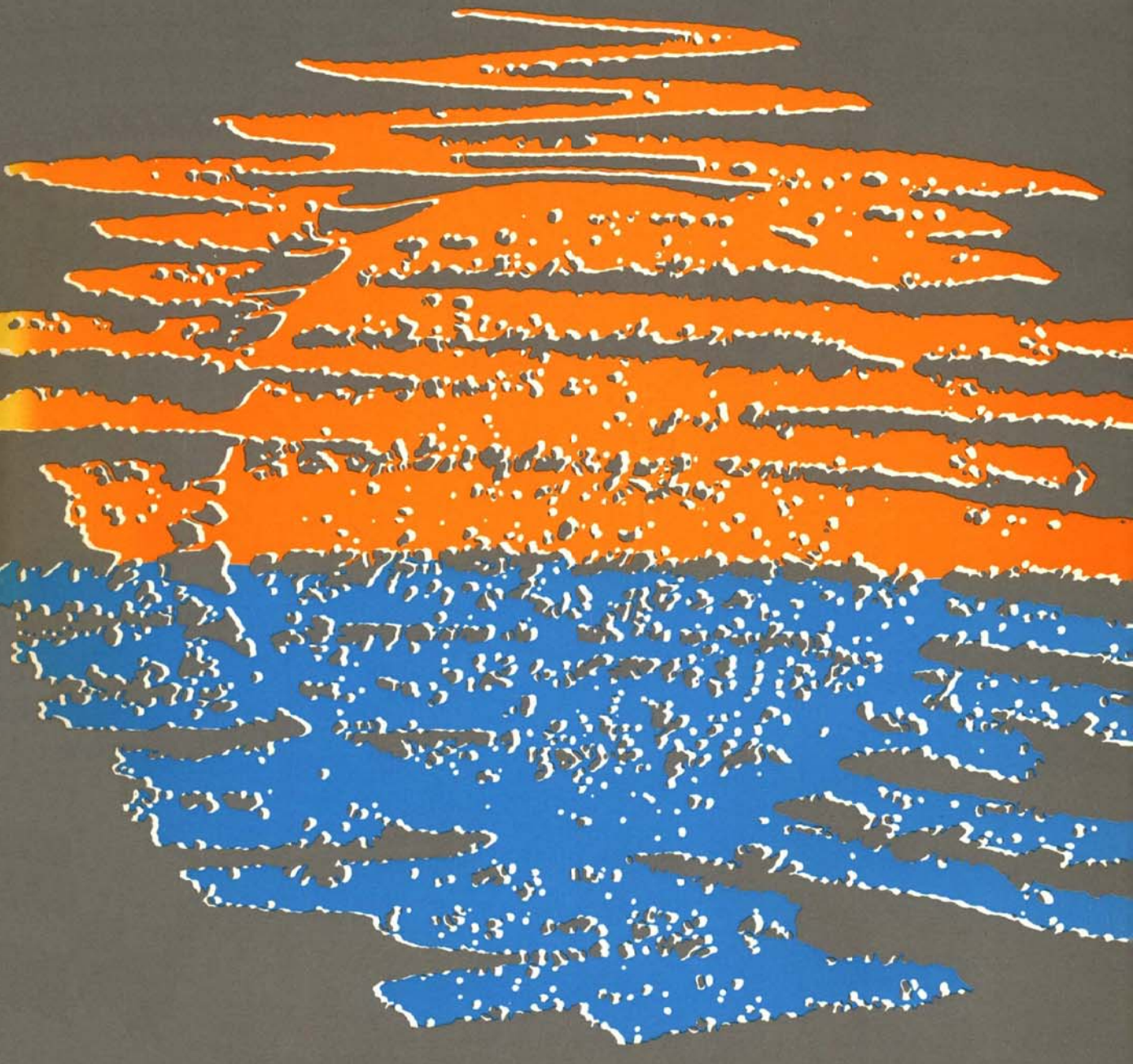
# The Global Research Agenda

## *A South–North Perspective*



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# The Global Research Agenda
# *A South–North Perspective*

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# *Introduction*

*As populations worldwide begin to reflect on the testament they will be leaving to their successors, vigorous efforts surely will be forthcoming to ensure, while time remains, that this decade reverses the shameful elements of the preceding nine.*

*Ivan L. Head*

Humankind enters this year the final phase of the 20th Century. In less than a decade, the current 100-year period will pass into the hands of historians for their assessment. They will have a cornucopia of events on which to feast: the conclusion of three centuries of colonialism, extraordinary advances in science and technology, fledgling steps toward a universal rule of law and — coincidentally — savage wars well beyond the limits of any previously fought, the first discernable movement toward environmental degradation on a planetary scale, and a disparity in living standards as between rich and poor greater than any previously recorded. Were the account to be written today, it would be witness to a period as perverse, as consciously greedy, as shortsighted as any since records have been kept.

As populations worldwide begin to reflect on the testament they will be leaving to their successors, vigorous efforts surely will be forthcoming to ensure, while time remains, that this decade reverses the shameful elements of the preceding nine. There is much to do. The indifference that now greets barbaric military practices and institutionalized acts of terrorism, the acceptance of immense disparities in wealth as between countries and between individuals within countries, the willingness to desecrate the planet's environmental future in return for immediate gain, the apparent abandonment of

commitments to justice and decency and equity — these attributes of the late 20th Century are surely not the kind that statesmen anywhere will wish to have engraved on their tombstones.

Ironically, the human species is now possessed of all the knowledge and all the resources necessary to mount a magnificent fin-de-siècle tribute to humanitarianism: knowledge that demonstrates unequivocally the destructive instabilities that await us all if major policy reverses are not soon introduced; knowledge that empowers us to undertake steps required to implement new policies; resources that are now wasted in nonproductive, often military-related ways. One of the available instruments takes the form of technology.

In all of history, technology has been the most powerful of change agents. But technology by itself is value-neutral. To be beneficial, as science and technology have been to the great majority of those living in the industrialized countries, they have been shaped and directed by wise policies. Equally wise policies are now required to ensure that past excesses are not continued, that present constraints on developing-country applications are removed, and that future destructive tendencies are eliminated.

Science and technology hold out much promise to the developing countries: promise to grow nutritious food, to protect health, to provide shelter and education, to husband the environment. Absent wise policies in all countries, that promise melts away in the face of greed and privilege. Those obstacles stand in the way of an enlightened epitaph to this century. Ten years is little enough time to remove them.

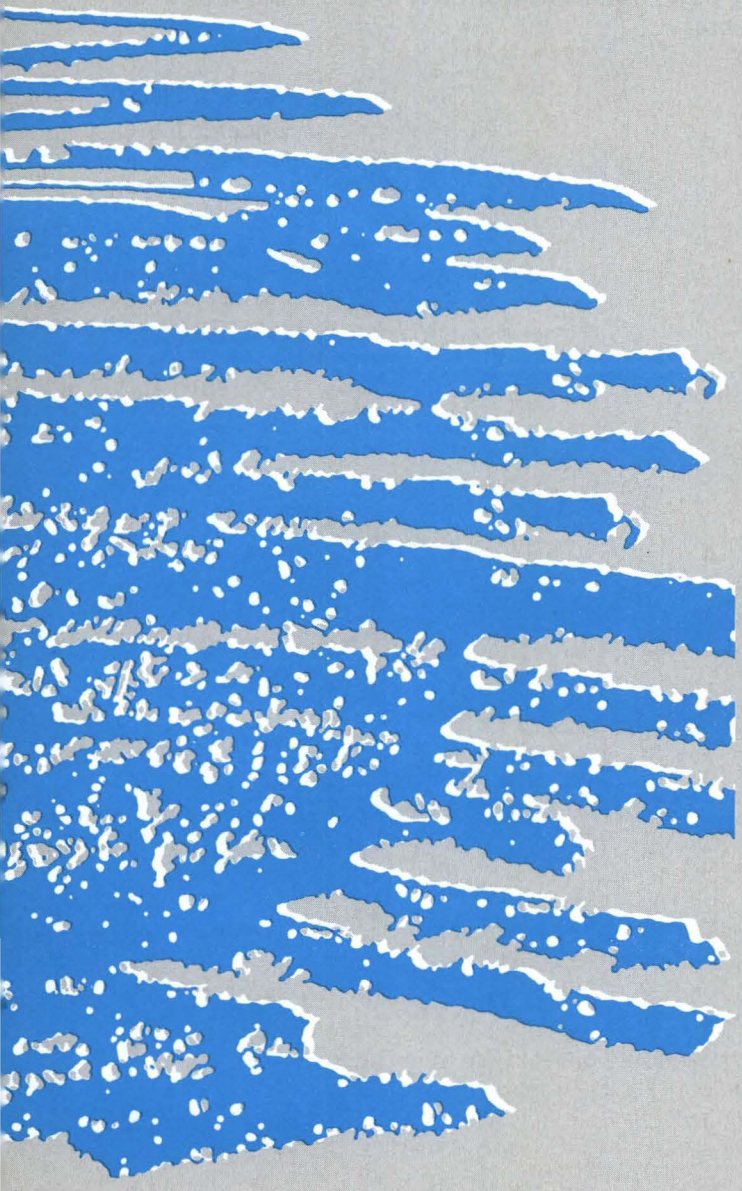
The absence of adequate education and research opportunities in the developing countries leaves them condemned to pursue outmoded, low-valued economic activity of a kind that is increasingly irrelevant to world market demand. In human terms, it means that the grip of absolute poverty will not be eased and that the scourges of malnutrition and ill health will persist.

Twenty years ago, the Parliament of Canada, in a farsighted and novel step, created IDRC (the International Development Research Centre) and gave to it a mandate to address these very issues. In the intervening period, IDRC has set new standards and broken much fresh ground in the pursuit of that mandate. IDRC remains the world's premier organization of its sort, yet its resources are modest. Only its dedication is unlimited. As it enters this final decade, the Centre has embarked upon an exciting period of innovation better to permit it to play an even more effective role: initiatives have been launched relating to IDRC as a learning community; departures have been taken from traditional modes of support; and various experiments have been undertaken with more coherent programing. There are many other examples as well. IDRC's external environment continues to expand in terms of the diversity and complexity of its needs. There are more actors involved — both partner institutions and other donors — and IDRC needs to remain nimble and observant of niches where it can respond in a way that exploits its comparative advantage to the full. A major part of that advantage is as a source of knowledge about developmental research: how to build vertical linkages to promote

utilization; how to create horizontal linkages, especially via networks, to raise research efficiency; how to build and foster indigenous research capacity; and how to innovate and learn from risks taken. Gathering, evaluating, and disseminating this knowledge is critical to enhancing IDRC's effectiveness, influence, and public image and to maintaining the funding and degree of autonomy that permits the attainment of excellence.

The following pages bear some testimony to the challenge as well as to IDRC's response.

*Ivan L. Head*
*President, IDRC*



# *Problems of the South and North*

## *Common problems, global solutions*

In the late 1980s, we have become aware of the existence of global problems. North and South alike share the same anxiety about global warming and the thinning of the ozone layer. Inhabitants of the industrialized countries are suddenly realizing that the civilization to which they owe their comfort has exhausted the planet's environmental capital. They account for only one-fifth of the world's population, but they are saying to the other four-fifths "forget about gasoline-powered automobiles, coal-powered heating plants, tree-cutting, and, above all, forget about refrigerators and air-conditioners," which will give us an increased risk of skin cancers. The "developing" countries provide proverbial revelations of the shortcomings and contradictions in the "developed" world.

This publication begins with some examples of problems created by the North to which the South threatens to give a new dimension, as well as Southern problems that create serious risks for everyone. The next section shows how scientists in developing countries can help solve global problems. In this context, the Third World is seen as an immense laboratory where a number of solutions to global problems are taking shape. Finally, the last chapter shows how scientists in developing countries can be helped to contribute fully to the solution of major world problems.

## *What we are doing to our planet*

"Global warming" and the "greenhouse effect" are terms that entered the political vocabulary only recently. Already, however, these concepts and the threats they represent are galvanizing the attention of decision-makers and the public in many countries. It is now highly probable that certain "greenhouse" gases accumulating in the atmosphere are heating the earth's climate and that this global warming will have profound and generally adverse consequences for millions of people — some of them already among the poorest in the world.

Scientists foresee a possible doubling in the build-up of carbon dioxide and other greenhouse gases in the atmosphere between now and the second half of the 21st Century. If this happens, the world's average surface temperature will rise by 2°C by the year 2030 and keep on rising, possibly by several degrees more as the century progresses. This may not seem like much, but it will be a faster rate of heating than at any time in history. Consider that the world has warmed by only 5°C in the 18 000 years since the last Ice Age ended.

Even a small increase in warming would raise sea levels around the world enough to inundate coastal states and create millions of "boat people" who would be without homes. It is projected that sea levels could rise by between 0.2 and 1.5 metres in 50–100 years.

For certain states situated close to sea level, the impact could be catastrophic. Maumoon Abdul Gayoom, the President of the Republic of Maldives in the Indian Ocean, has already described his country of 200 000 people as an "endangered nation." Other low-lying Pacific island nations could simply disappear altogether, as well as large chunks of Bangladesh and Egypt. Egypt, for instance, foresees the possible loss of one-fifth of its fertile farmlands through salt-water inundation brought about by a projected 1-metre rise in sea level. Up to 46 million people could be forced to flee the delta regions of Bangladesh and Egypt alone, according to a recent study by the Woods Hole Oceanographic Institution. In Canada, the Îles de la Madeleine and Prince Edward Island could be badly flooded.

For every country, the effects of global warming will be extremely uncertain. There is virtually no way of predicting in advance the effects on local or regional weather patterns. Much will also depend on how rapidly climatic changes occur and whether nations can cope with the potentially disruptive effects on local agriculture, including possible interruptions to food supply, caused by variations in temperature and rainfall.

Some countries could end up benefiting from new agricultural production opportunities as the weather warms up and the climate stabilizes. The north of Canada and of the Soviet Union, for example, would probably become more hospitable to crops, making for a more diversified economy. These countries would also have longer growing seasons. All countries would be wise to pursue a policy of agricultural diversification to withstand the possible shocks of climate change. This is yet another reason why efforts should be redoubled to collect and preserve genetic material for plant breeding, an activity that must be concentrated in the Third World where most food crops originate.

## *Preparing for climate change*

Despite the increasing evidence, there is no complete agreement among scientists that the warming effect will be so severe, only that it is likely to happen. Scientists from nordic, temperate, and tropical countries will all have to take part in joint research programs if the results are to be meaningful and accepted by politicians in the many countries, rich and poor, where crucial actions will have to be taken. Governments, in the North and in the South, will come to depend increasingly on scientific advice, both to foresee the effects of global warming and other major problems and to anticipate or deal with consequences. Rather than pursuing research motivated by intellectual or commercial interests, researchers and technologists will have to align their work more closely with people's welfare and contribute to solving global problems.

## *Our gene bank is in the South*

The Third World is the source of more than half of the genes of plants used in the West to develop medicines or improve agricultural species. The burgeoning concern to conserve plant genetic resources has led to the establishment of a number of different gene banks — the refrigerated stores for precious genetic material (germ plasm), which is used to develop new crops with higher yields or new medicines with more resistance to disease. Gene banks are meant to meet the requirements of agronomists and plant breeders for genetically variable parents. Between 1975 and 1986, their number more than quadrupled from 8 to 38, containing 100 important germ-plasm collections worldwide.

Several related factors have spurred this search for new plant genes in recent years: the fear that a great many varieties vital to future crop improvement are being eliminated by development and the destruction of tropical forests; the replacement of thousands of native cultivars with a few high-yielding ones that, because of their genetic uniformity, are more vulnerable to pest epidemics; and new opportunities afforded by tissue culture and genetic engineering for moving genes across the barriers of different species.

The conservation of plant genetic resources has become a controversial issue in South–North relations. Many developed countries have adopted legislation giving plant breeders the right to own patents on new varieties, with the result that developing countries, although their genetic resources go into the making of modern varieties, may acquire those varieties only on commercial terms. Mexico and Peru, for example, have to pay royalties to the United States for new amaranth varieties, even though the flower is native to these two countries.

Consequently, a new concept of "farmers' rights" has come into being that recognizes the informal innovations and refinements made by generations of Third World farmers to today's crop diversity, which is the result of accumulated generations of selection, breeding, and investment. This concept was approved by the 158-member nation Food and Agriculture Organization of the United Nations (FAO) in November 1989.

Determining how to reward Third World innovators, however, is much more complex. As asked by *South* magazine in September 1989: "Who in Mexico, for example, should be compensated for maize improvements at the time of the Aztecs? Should every variety be traced back to its origins? Even if this were possible, which country should be paid, given that plants do not obey national boundaries?"

The solution of a 117-nation Commission on Plant Genetic Resources set up by FAO is to acknowledge that plant genes are part of the common inheritance of all farmers. It recommended that countries pay into a new gene fund at the United Nations to finance community projects that promote plant diversity. There has been debate over whether payment into such a fund should be voluntary or mandatory.

From its inception, IDRC has supported dozens of projects to strengthen the expertise and capacities of plant breeders in the Third World and has contributed to the setting up of gene banks for crops not collected elsewhere.

A vast study of the oceans, whose behaviour is perhaps least understood yet so critical to climate change, will not be completed until the late 1990s. Several new, major international undertakings, including the International Geosphere–Biosphere Programme, which seeks a better understanding of the effects themselves, and the Human Dimension of Global Change Programme, which looks at appropriate policy responses, will attempt to integrate the mass of studies into an overview of "global change."

## *Probing the greenhouse effect*

It is already too late to stop global warming — the principal gases responsible for building up heat have been accumulating in the atmosphere since the dawn of industrialism but especially since the 1950s. The warming, however, can be slowed and the suddenness of climatic change blunted if actions are taken now to control or curb future emissions of the greenhouse gases. These gases combine with water vapour to block the reradiation into space of the sun's infrared rays, trapping solar heat inside the atmosphere. Like the glass of a greenhouse, the gases admit sunshine but prevent heat from escaping.

Corrective action implies, most of all, reducing emissions of carbon dioxide ($CO_2$) by burning less coal, oil, and natural gas, the fossil fuels that together account for half of all greenhouse emissions. One-fifth of the world, the population of the rich countries, consumes 70% of this fossil fuel energy. Much of it — more than one in every three barrels of oil — is consumed by the 500 million cars and trucks on the road, most of them in developed countries.

The US is currently the leading source of $CO_2$ (23%), followed by the Soviet Union. Canada's share of world emissions is 2%. By contrast, Japan, the nation with the highest per-capita income and the second largest gross national product (GNP), produces only 5% of emissions, having switched significantly to natural gas, a cleaner fuel than either coal or oil, and invested in energy efficiency after the oil supply scares of the 1970s.

Efforts to reduce consumption of coal, the dirtiest fossil fuel, could be thwarted by China and other nations that are currently expanding their production. Coal is the world's most plentiful fossil fuel, with proven reserves sufficient to last several centuries. China has about one-third of world reserves and plans to build many more coal-fired power stations to meet the demand for electricity — many Chinese factories, for instance, have only enough power to operate part-time. India and North Korea also use coal extensively for 65 and 90% of their commercial energy needs, respectively. Buoyed by international demand, nations including Colombia, Indonesia, and Venezuela have recently become coal exporters, while domestic coal development is being studied from the Philippines to Iran.

The World Bank, the major funder of coal-fired, electricity-generating stations in developing countries, announced a shift in favour of natural gas projects in 1989 for environmental reasons.

Nevertheless, the many stations that have been built will continue to require coal (Australia, South Africa, and the US are the main exporters). Although natural gas deposits have been discovered in about 50 Third World countries, relatively little exploration and production have taken place.

International talks to work out an approach for reducing the use of fossil fuels were begun informally in 1989. The rich economies will naturally be reluctant to make drastic cutbacks, whereas the developing world needs more energy for its development, not less. It is plain, however, that energy conservation presents the only proven, rapid, and permanently effective way of reducing carbon dioxide emissions from burning fossil fuels. Indeed, in the absence of more vigorous conservation than anything seen to date, global warming is simply inevitable, no matter what else is done. As indicated through meetings attended by First, Second, and Third World scientists, such programs are not only feasible but also economic in every country of the world, rich or poor.

Developing nations contribute between 10 and 20% of global carbon dioxide emissions through the deforestation that occurs on their territories. Forests constitute a large "sink" for carbon, which is released into the atmosphere in the form of carbon dioxide when trees or vegetation are burned or cut. In the regions where forest clearance is greatest, Latin America and Southeast Asia, deforestation produces 75% of the carbon dioxide emissions. Carbon levels can be restored or increased, and carbon dioxide in the air reduced, by massive planting of trees and shrubs, increasingly a priority in many countries.

The US Environmental Protection Agency issued a report in February 1989 saying that 40% more global warming could occur by 2050 if the developing countries fail to adopt "climate-stabilizing policies" — meaning a cutback in both fossil fuel use and deforestation.

## *Methane's race*

Although much is known about carbon dioxide, scientists know far less about another powerful greenhouse gas, methane, which escapes into the air from leaky pipelines, the stomachs of cattle, the garbage in waste dumps and landfills, even disused coal mines — wherever bacteria break down organic matter in the absence of oxygen.

Methane is said to have 25 times the heat-trapping properties of carbon dioxide and is entering the atmosphere at an increasingly rapid rate. Assuming that $CO_2$ levels are brought under control early in the next century, methane could well become the leading greenhouse gas. Knowledge of how much methane is produced, by what source, and in what countries is, however, still rudimentary. Only in 1982, for example, did researchers in Kenya and several Western countries discover that termites were converting most of their woody food into carbon dioxide and methane. Given that termites are found on two-thirds of the world's land area and eat one-third of its vegetation, an increase in the termite population could help explain the higher

levels of methane. The termite population could be growing as farmers replace tropical rain forests with pasture because termites favour grasslands.

Irrigated rice fields, swamps, and bogs are thought to be major sources of methane. Chinese scientists in Zhejiang province have recently set up instruments to measure the methane released from paddy fields. This is reported to be the first such experiment in Asia and has revealed much higher emissions than those observed from European paddies. India, home to irrigated farming and vast numbers of cattle, is thought to be perhaps the largest single producer of methane, yet there are no measurements of methane fluxes over India.

Normally, bacteria in soils help cleanse the air of excess methane. But a new US study suggests that acid rain, common throughout North America and Europe, as well as widely used nitrogen-based fertilizers inhibit this cleansing action, keeping more methane in the atmosphere.

Some scientists fear that, as the warming trend takes effect, methane produced by the great northern bogs of Canada, Scandinavia, and Siberia will add a compounding effect to the heating trend, further raising Arctic temperatures. The area near the poles may warm faster than other parts of the planet in coming decades, releasing the methane trapped in the wetlands under the tundra. This kind of feedback effect, in which one warming source stimulates another, is one of many unknown and underresearched mysteries in the field of global warming. One speculation is that higher temperatures will spark forest fires — as may have happened already in Manitoba in 1989 — accelerating carbon dioxide emissions. Warming could also release methane trapped in the deep oceans.

Another key greenhouse gas, nitrous oxide, also more potent but less plentiful in the atmosphere than carbon dioxide, is likely to prove as stubborn to check and control as methane. Nitrous oxide is entering the atmosphere faster than it is being removed, but there is no clear understanding why. Sources of the gas include coal-fired chimneys and automobile engines.

Scientists are also looking for a major unknown source of nitrous oxide — according to Paul Crutzen, the Dutch scientist who developed the "nuclear winter" theory, it is likely to be found in the tropics. Recent studies in Brazil have demonstrated that soil exposed after tropical forests are cleared or grassland is converted into pasture emits nitrous oxide. Yet another source could be the nitrogen-rich fertilizers used increasingly in both temperate and tropical agriculture. Research into the sources of nitrous oxide still has far to go.

A fourth major contributor to the greenhouse effect, is the chlorofluorocarbon (CFC) family of gases, which are manufactured chemicals with many industrial applications. They are used as refrigerants and insulators in fridges and air conditioners, as the beads in plastic foam, as propellants in aerosol sprays, and as solvents for keeping computer chips clean. CFCs are extremely effective heat-trapping agents, up to 20 000 times more effective for this purpose than carbon dioxide per molecule. Besides contributing to global heating, CFCs also deplete the stratospheric ozone layer, which

shields the earth from dangerous ultraviolet rays. This type of radiation promotes skin cancer, cataracts, and weakened immune systems in humans and can also kill fish and plant life. While carbon dioxide and deforestation represent one half of the greenhouse effect, together, methane, nitrous oxide, and CFCs make up the other half.

## *Protecting the ozone layer*

The thinning of the ozone layer has dramatized the double damage being done to the global environment by CFCs, 80–90% of which are produced and used in industrialized countries. Ozone is destroyed when chlorine from CFCs and bromine from halons, used in fire extinguishers, float into the upper atmosphere, breaking down the molecules in the Earth's protective ozone shield.

A "hole" has appeared in the ozone layer over Antarctica each spring since 1979. According to a report in *Nature*, "ozone-poor" air from the Antarctic has already spread over southern Australia and New Zealand. Around the world, the average concentration of ozone in the stratosphere fell by about 2% between 1969 and 1986, much faster than had been predicted. The depletion rate in the industrialized northern part of the world was 3% year-round and 4% in winter.

Although industrialized nations have benefited most from the possession of CFCs, scientists are increasingly apprehensive that ozone depletion will have its greatest impact on the South, threatening food supplies and perhaps sparking shortages. Until recently, there was little hard evidence on the effects of increased exposure to ultraviolet radiation. But in September of 1989, a panel of 48 scientists reported to the United Nations that there would be increased damage to small fish and other marine life, which are main sources of protein in developing nations. Some 24 mainly industrialized nations signed a protocol in Montreal in 1987 undertaking to halve their production of CFCs by 1998 (the number of signatories is now more than 30). New evidence of harm has persuaded scientists to urge a worldwide ban on CFCs as soon as possible, and proposals to stiffen the protocol in that direction will be considered at another meeting in 1990. The Montreal protocol gave developing countries a grace period until 1989, during which they could continue producing CFCs before being obliged to start cutting their use by 50%.

China and India have balked at limits on their production and have not signed the protocol, arguing that Third World countries should not be held responsible for destruction of the ozone layer and that the technology of producing CFC substitutes, now being developed in industrialized countries, should be provided free or at very low cost to the Third World. China is the country that can most undermine the international control effort through its plan to put a refrigerator in every home by the year 2 000 and to boost production 10-fold in the next decade of the two most widely used CFCs. This would put China in the big league of CFC producers, with an output greater than that of the US today. By selling China obsolete equipment with which to make

refrigerators, Western and Japanese companies are helping to ensure that CFC production will continue at high levels into the future.

Although research into substitutes is quickening, developing nations are worried that they could become available only on commercial terms and would be too costly to many countries. India has proposed that rich countries set up a fund to compensate Western chemical and technology firms that will agree to transfer the know-how of substitutes and conservation and recycling techniques (to prevent the escape of the dangerous chemicals into the environment) free to developing nations that sign the protocol. "The question that haunts us," the Indian delegation said at a conference on the subject, "is the extent of resources required to get the technology as well as the products from the companies in the developed world."

This is an example of a seemingly small industrial activity, first seen as beneficial, becoming a dramatic and unforeseen threat in a short time. What other surprises are in store?

## *New global threats to health*

In the 1980s, the new global health threat was AIDS (acquired immunodeficiency syndrome). An unknown disease before 1981, AIDS has grown quickly into a worldwide epidemic infecting between 5 and 10 million people, according to the World Health Organization (WHO). Full-blown cases of AIDS have been reported in 140 countries. Although the HIV virus, which causes AIDS, was not discovered by modern medical science until 1981, the disease itself is probably not new. Some of the most prominent AIDS researchers believe the virus has existed, perhaps for centuries, in a low-lying state somewhere in Africa. What prompted its emergence and spread in Africa were certain conditions that remain rife throughout the Third World — conditions that, these scientists believe, could lead to other, possibly more threatening, viral epidemics in the future.

One of these factors is the movement of people into new areas, particularly cities. Viruses that were once restricted to certain isolated locales, amid stable ecological conditions, may erupt and become more virulent in densely populated urban areas. More than that, the overcrowding and squalor of the poor in Third World cities provide ideal conditions for viruses to spread. The crowding of people and the increased rodent and animal population help to turn aspiring viruses into more dangerous infectious agents.

The AIDS virus could have come into African cities with the movement of infected people from the countryside, and was then carried to other countries by travellers unaware that they were themselves infected. Aircraft travel was the means that gave the AIDS virus its global reach, despite its otherwise "slow" method of transmission through intimate sexual contact or blood exchanges. Trade in blood products, a new form of commerce, may also have played

some part in the virus's passage from South to North. Among the factors that have helped AIDS to spread is an increase in the number of sexual partners, which has been a critical element in both North and South. Prostitution is extensive in several developing countries where women face unprecedented poverty and discrimination and where traditional social supports for both men and women are under stress.

AIDS aside, there is no dispute among the specialists that new viral epidemics will emerge in the Third World in future and that some of them may pose an even greater danger to the world than AIDS. There is enough viral "fire power" in the tropics, scientists say, to wipe out a large segment of the planet's population. Past epidemics have frequently broken out when human activities have disturbed the ecological balance or when people have invaded previously undisturbed terrain such as rain forests, where many unknown viruses are believed to be lurking.

Sudden new outbreaks of life-threatening diseases have occurred periodically in the last 20 years or so. In the late 1960s, for example, West German scientists working on a polio vaccine fell mysteriously ill, and several died, from what came to be called the Marburg virus. This virus, then unknown, had infected the batch of imported monkey cells the scientists were working with. In 1976, a similar disease, the Ebola virus, killed about 500 people in Sudan and Zaire, including many doctors and nurses treating infected patients.

In 1977, millions of people in Egypt and South Africa came down with Rift Valley fever, a disease that incapacitates the body and damages the retina. The virus responsible mysteriously shifted from its usual hosts of sheep and cattle and thousands of people died of the disease in Egypt. One theory offered was that the new irrigation provided by the Aswan high dam brought about an increase in population density in the irrigated areas and, consequently, increased exposure to infected animals.

In Argentina and Bolivia, the settlement of new land for agriculture several decades ago caused a population explosion of virus-carrying mice, exposing the human settlers to deadly hemorrhagic fevers that cause uncontrollable bleeding. In more recent times, the virus that causes Lassa fever, an often fatal disease, spread from rats to humans in Nigeria after diamond prospectors occupied a previously uninhabited area. The mining and settlement boom of the 1980s in the Brazilian Amazon has seen the incidence of malaria in that region almost double from an estimated 280 000 cases in 1983 to 500 000 cases in 1988.

Another deadly hemorrhagic fever, this one caused by a virus discovered in Korea in 1976, has been reported among poor people living in Baltimore in the US. The virus is apparently prevalent there in rats. The Delta virus, discovered in Italy in 1977 and found mostly among drug addicts in Europe and North America, infects the liver of hepatitis B victims. Fortunately, it has not yet spread to Asia, where hepatitis B is a common disease.

## *Travelling flus*

New and threatening strains of the influenza virus arise from time to time, usually they are named after the Chinese population centres where they originate (the Hong Kong, Shanghai, and Taiwan flus). It has been suggested that this virus's activity may be linked to the practice of integrated fish farming among the Chinese, a practice that brings fowl, fish, and pigs together in close living environments. These are questions to be pursued by research.

The upswing in viral disease has prompted a call by virologists for a worldwide program of viral "listening posts" in densely populated Third World centres and in the neighbourhood of rain forests. Such a network would include modern laboratories and, perhaps, a "red alert" global reporting system as advocated by numerous scientists. Skill upgrading is also needed in identifying the more commonly known viruses. In Central America, for example, four of the top six laboratories in a recent survey could not consistently identify the polio virus correctly.

Another way viral or parasitic diseases are spread is through insects. As global climate and agricultural patterns change, so will the range and disease-carrying capacities of mosquitoes and other insects. Mosquito-borne diseases such as malaria, yellow fever, and dengue are experiencing a resurgence throughout the world — and the threat to Canada from these diseases is growing.

Dengue fever is a potentially fatal disease that has spread into the US and could come to Canada. Since 1976, more than 2 million cases have been reported in Brazil, after a 50-year absence there, and it has spread through much of South America and the Caribbean. Transmitted by mosquitoes, dengue (pronounced "denngi") produces symptoms ranging from rashes and aches to severe bone pain, hence its nickname "break-bone fever." In the form of dengue hemorrhagic fever, it causes internal bleeding, shock, and death, mostly in children. Dengue strikes 100 million people in the tropics and kills thousands annually in epidemics that flare up periodically in East and Southeast Asia.

Outbreaks of dengue have occurred as far north as Texas, and the disease seems to be travelling on a northward path. Mosquitoes carry the infection from person to person after biting someone who is infected — that person could be a traveller. Of the two types of mosquito that can transmit dengue, one, known as *Aedes aegypti*, is present in many parts of the United States. The other, *A. albopictus*, has been reported in a dozen US states including Iowa and Michigan, having made its entry into North America in shiploads of used tires imported from Asia. The mosquito breeds in the watery cavities of the tires, millions of which have been imported for retreading. According to a health official, *A. albopictus* may be present in Canada too. Since 1978, IDRC has funded several research initiatives to help Brazil, Cuba, Honduras, Indonesia, and Mexico fight dengue. Who could have known 12 years ago that this "tropical disease" would become a threat to Canadians?

Malaria, another mosquito-borne disease, has also experienced a worldwide resurgence. Some 100 million new cases of malaria are reported annually, resulting in about 2.5 million deaths a year in tropical countries. Malaria-carrying mosquitoes have even infected people in and around airports in Britain, France, the Netherlands, and, most recently, Switzerland — having reached Europe aboard the big jets from the tropics. Only a few generations ago, malaria was endemic in several areas of Europe and even in some parts of Canada. It is ironic that malaria-carrying mosquitoes would be brought back because of our advances in transportation.

## *Two centuries and five billion people later*

Incredible as it seems today, the entire population of the world 200 years ago was smaller, and growing more slowly, than the national populations of present-day India or China. Since then, the world total has grown from around 800 million to about 5.3 billion. Population growth will continue into the foreseeable future, rising to about 6.2 billion by the year 2000, with 9 out of 10 new births occurring in developing countries.

This means the addition of nearly 100 million more people a year in this decade alone — equivalent to a new Bangladesh or a quadrupling of Canada's population annually. Such extra numbers can only add to the pressures already being felt in developing nations and, directly or indirectly, in rich countries as well.

Millions of peasant farmers in the Third World are finding it harder to make a living on small plots or eroded soils as population growth forces them into more and more marginal areas. Lack of sufficient arable land, or its concentration in the hands of a small proportion of landowners, forces peasant cultivators into a mode of shifting cultivation on soils too poor to withstand continual use. More and more, forests are cleared to provide new ground for subsistence. When the forests are opened up by loggers, the migrant farmers are not far behind.

Lack of secure land tenure provides no incentive for farmers to stay put and invest in their plots, no matter how small. The pressure on land is made more intense when large tracts are tied up for speculative or unproductive purposes, or for such export industries as the raising of cattle, an activity that requires much land but very little labour. In Brazil, where both conditions apply, 2% of the total number of landowners control 60% of the arable land, while 70% of all rural families are landless. This statistic helps explain why up to 10 million migrant farmers have cleared patches of the Amazon forest for subsistence agriculture since 1970 in the world's most notable — but by no means unique — case of deforestation.

As arable land dwindles, pressure on the remaining land base becomes intense. Soils are overworked, overgrazing takes place, erosion worsens, and the land is robbed of its productivity.

Marginal land, more susceptible to erosion and drought, is put under cultivation. There is growing concern that too much of the world's food comes from land where production is unsustainable. During the last 2 years, the world's cereal production has decreased and there is now a new global concern about the planet's capacity to feed the actual world population.

In the Third World, those who become unable to obtain their food from the land, head in by the millions to the towns and cities, bringing their hopes and poverty with them. Urbanites made up 17% of the Third World's population in 1950; today, the proportion is a little less than 50% — but growing. Of the three developing-world continents, Latin America has the highest urban population rates; this is the continent where inequality in landholding is greatest.

Big Third World cities are like no cities previously known: monstrous in size, lacking many basic services, and not supported by an adequate base of economic development. Pollution fills the air from thousands of cooking fires, automobile exhausts, and industrial smokestacks, and garbage piles up, seldom collected. Sewage systems are available only to the well-off. It has been estimated in São Paulo, Brazil's largest city, that 30 more city budgets would be needed to make up the deficiencies in city water, sanitation, and road systems.

These are not always pleasant cities in which to live, yet the shanty towns and fringe settlements, bunched like overgrown villages, are an improvement for many rural people because they can have access to hospitals and schools. At least there is the prospect of making some kind of living in the ubiquitous "informal economy" of street pedlars, casual labourers, and unskilled tradespeople, if formal employment cannot be obtained. In Lima, Peru, up to 50% of the active labour force are thought to receive their meagre incomes in this informal economy.

The dominant demographic profile is young; 35% of Third World populations are under 14. "Street children" number between 20 and 40 million, it is estimated. Many youths, apparently alienated from conventional norms, group together in gangs.

Municipal administrators are overwhelmed by the sheer scale of urban problems and such threatening dilemmas as urban subsidence, because of overpumping of water, or the contamination of the water supply by salination, sewage, or waste. As urban growth rates soar, many cities will become more unlivable. Mexico City, which in 1950 had 3 million inhabitants, is expected to accommodate nearly 25 million within 10 years, an unprecedented rate of growth. New York City, by contrast, acquired its 8 million population over 150 years.

Dissatisfied populations are increasingly seeking entry to Northern industrialized countries as immigrants or asylum seekers. By mid-1987, some 70 000 skilled Africans had left the continent for Europe and North America, an increase of 30 000 from 1985. The unfortunate effect of this "brain drain" from Africa's viewpoint is that it has robbed the continent of needed, skilled resources. Similarly, the current migration of people and money from Hong Kong is benefiting Canada and other Northern countries financially. Although rich immigrants are

welcomed, Canada and other Northern nations try to control the arrival of poor people.

Refugee movements around the world are becoming more international in scope. At one time, most refugees would remain temporarily in their own regions, expecting to return home in the near future. Today, many Third World refugees set their sights on coming to Europe or North America. Strict border controls do not always hold them back. Illegal migration for purely economic reasons is also a growing international problem — "illegals" in the US, for instance, number between 4 and 6 million, most of whom pour over the Rio Grande from South America and some of whom make it to Canada. Officially, the United Nations recognizes about 13 million refugees globally.

## *The world's debt crisis*

The accumulation of large debts since the mid-1970s has led to an ongoing, ballooning crisis in the finances of many Third World nations. Servicing these debts has bled these countries of funds needed in overcoming underdevelopment in their own economies and has set off a series of economic shock waves that continue to reverberate in the world's financial system.

Total Third World debt now stands at more than US $1.3 trillion and has doubled since 1980. Rising interest costs, stemming from high rates charged in the lending nations since 1979 as a strategy against inflation, mean that 50% or more of the annual debt servicing is made up of interest payments rather than principal. A 1% rise in interest rates raises the Third World's debt by US $9 billion.

In a country like Kenya, debt repayments mean the difference between a 4 and a 6% national growth rate, said that country's Minister of Finance, George Saitoti, meaning that Kenya barely struggles to keep ahead of its 4% population growth rate, the highest in the world. Debt servicing consumes more than 40% of export earnings in Latin America and closer to 50% in sub-Saharan Africa, where two dozen of the world's poorest countries are located. Although Latin America is the most highly indebted region, having borrowed more money, the burden of repayment falls just as heavily, or even more so, on some truly poor African countries and on small nations like Jamaica and Costa Rica whose current capacity to repay is extremely limited.

Because Northern banks have virtually stopped lending to debtor nations and foreign aid flows have also slowed down, developing countries find themselves making a net financial contribution to the industrialized countries in the form of debt servicing. The debtor countries paid principal and interest in 1988 totalling US $142.4 billion, but received only US $92.3 billion in new loans or aid. The US $50.1 billion difference in 1988 represents a massive financial transfer in 1 year from the Third World to the rich countries. Such "reverse transfers" to the North have been flowing in increasing

amounts since 1984, helping to finance the Northern world's deficits and growth needs.

In the meantime, poverty in the South has worsened as the indebted nations have drastically cut back imports and domestic spending to service debts. One indication is that income per capita has fallen 6.5% in Latin America and 25% in sub-Saharan Africa since the start of the 1980s — in effect, a lost decade for development in those regions. Wages have fallen and unemployment has increased as growth has slowed or stopped. Moreover, the social programs needed to assist people in times of difficulty have been part of the budget cuts that the Northern-controlled international financial institutions have imposed on the debtors as conditions for new loans or rescheduling past debts. Lately, the World Bank and International Monetary Fund (IMF) have been having second thoughts about this aspect of their "adjustment" programs and have begun to reevaluate their policies.

After years of resisting Third World calls for debt relief, Northern commercial banks and their governments have finally yielded to the likelihood that some of the loans they made, not necessarily wisely, are unlikely to be ever repaid in full, and the banks have begun to "provision" themselves against future losses, without in any way diminishing the pressure on the debtor countries. Canadian banks are owed about $24 billion in Third World debt.

An improvement in the South will open up new markets for industrialized nations, especially those dependent on trade. The future export demand for Canadian grain, for instance, will virtually all come from Third World countries, including many indebted ones that have had to cut back on significant food imports. These markets will grow to the extent that the Third World's income and consumption rises. According to the North–South Institute of Ottawa, the plight of the most indebted countries cost Canada something like $24 billion and 130 000 jobs in lost exports over a 7-year period in the 1980s, and losses on a similar scale are duplicated in other industrialized countries. From this financial standpoint, let alone the moral case, the North too is losing from the South's illiquidity.

## *The international drug menace*

Illegal narcotics production has become a huge, worldwide industry of significant importance to numerous economies. Indeed, millions of peasant farmers throughout the world would be bereft of income if the markets for heroin, cannabis, and cocaine were to dry up. This is not likely to happen, so long as demand for the illegal drugs keeps growing, especially from affluent Northern countries where high prices are paid. Alternative economic activities in the producer areas, if such alternatives exist, provide nowhere near the returns paid to the producers of drug-related crops, even though the peasant producers are themselves almost universally poor receiving only trifling sums compared with the proceeds collected by the traffickers and their intermediaries.

Events in Colombia have shown that the wealthy drug lords and their private armies are capable of challenging the state itself, instituting a reign of terror when their interests are crossed, and even sending hit squads to Canada and other countries to rescue imprisoned traffickers or pilots. The huge profits from drug sales spawn the proliferation of weapons in private hands in both producing and consuming countries. In the United States, for instance, armed gangs patrol neighbourhoods where cocaine use is rampant and where rising crime rates reflect the addicts' need for constant cash. Drug operations have infiltrated and corrupted the routine operations of governments in a score of countries, the most dramatic case being Panama.

Production is spreading. Poppy cultivation, rare in Guatemala a few years ago, has displaced fruits and vegetables over thousands of hectares of rich agricultural land in Guatemala in the late 1980s to the point where this one country alone can reportedly supply more than half the opium needed for the heroin consumed in the United States.

Coca leaf production has expanded sevenfold in Peru and Bolivia since the mid-1970s, and opium production is increasing in both the "Golden Crescent" (Afghanistan, Iran, Pakistan) and the "Golden Triangle" (Burma, Laos, Thailand), as well as in Mexico. Canada has emerged as a major transshipment point for Asian heroin entering the United States.

Because US surveillance has tightened, American money from drug sales is increasingly being transferred abroad through the medium of the Canadian banking system. Cash is often carried into Canada by couriers and then laundered through legitimate enterprises or sent abroad through the financial institutions by electronic means. In the United States, drug revenues are worth well over US $100 billion; in Canada, an estimated $10–13 billion. As a result of increased laundering, major Canadian banks have mounted new programs to try to spot suspicious transactions, but most of the illicit money is believed to get through.

Police say drug use — especially of cocaine and its derivative, crack — and drug-related crimes are rising in Canada. Drug trafficking is the single most lucrative and widespread criminal activity in the country.

## *Military threats to security*

As East–West détente proceeds, the likelihood of conflict between the superpowers and their allies recedes rapidly. In the Third World, however, instability combined with such factors as ethnic conflict and future resource shortages provide steady conditions for the outbreak of wars and expansion of international tensions. Almost all the military actions in recent decades have taken place in the South.

Ironically, as the United States and the Soviet Union become serious about controlling their armaments, the weapons available to Third World states — and to irregular groups like terrorists, drug traffickers, and guerrillas — become more lethal than ever.

Chemical weapons, for instance, are in the possession of about a dozen states and were used extensively in the Iran–Iraq war. They range from primitive blistering agents to blood poisons and the nerve gas that was used against Kurdish civilians at Halabja in April 1988. Known as the poor man's atom bomb, many chemical weapons are relatively easy to manufacture from ingredients sold commercially on the open market. Thus, control over their production is extremely difficult. Although the superpowers are moving toward scrapping their chemical weapons, the following states are believed to have them: China, Ethiopia, India, Iran, Iraq, Israel, the Koreas, Libya, South Africa, Syria, Taiwan, Vietnam.

In a similar way, the rich nations have not been able to prevent India, Israel, Pakistan, South Africa, and a few other countries from acquiring nuclear weapons or the ability to produce them. Some of these emerging nuclear states — Argentina, Brazil, and China, for instance — are beginning to supply modest amounts of know-how and weapons-usable material to other buyers. None of the new suppliers has agreed to the system of safeguards designed to stop proliferation.

According to the Stockholm International Peace Research Institute, at least 22 Third World countries are trying to build or buy ballistic missiles, which can travel so fast that they cannot be shot down before reaching their destinations. Saudi Arabia has acquired CSS-2 missiles from China that can, if fired, strike Tel Aviv. The United States has objected to France about a proposed sale of rocket motor technology for Brazil's space program, arguing that the technology could be used to make missiles and that could find their way through Brazilian arms sales to the Middle East. The US has also refused to sell India a system for testing the reentry of missiles. Meanwhile, British newspapers have reported cooperation on missile development between companies in Argentina, Egypt, and Iraq in a scheme linked to Western companies supplying technology.

Ballistic missiles can be fitted for either nuclear or chemical weapons. But some new and exotic conventional weapons can deliver almost as much punch. One is a fuel-air device that disperses explosive gas over a large area and then ignites it. A plentiful supply of new weapons is available to the South through the international arms trade. As Northern countries discard old weapons, these stocks too will find their way South.

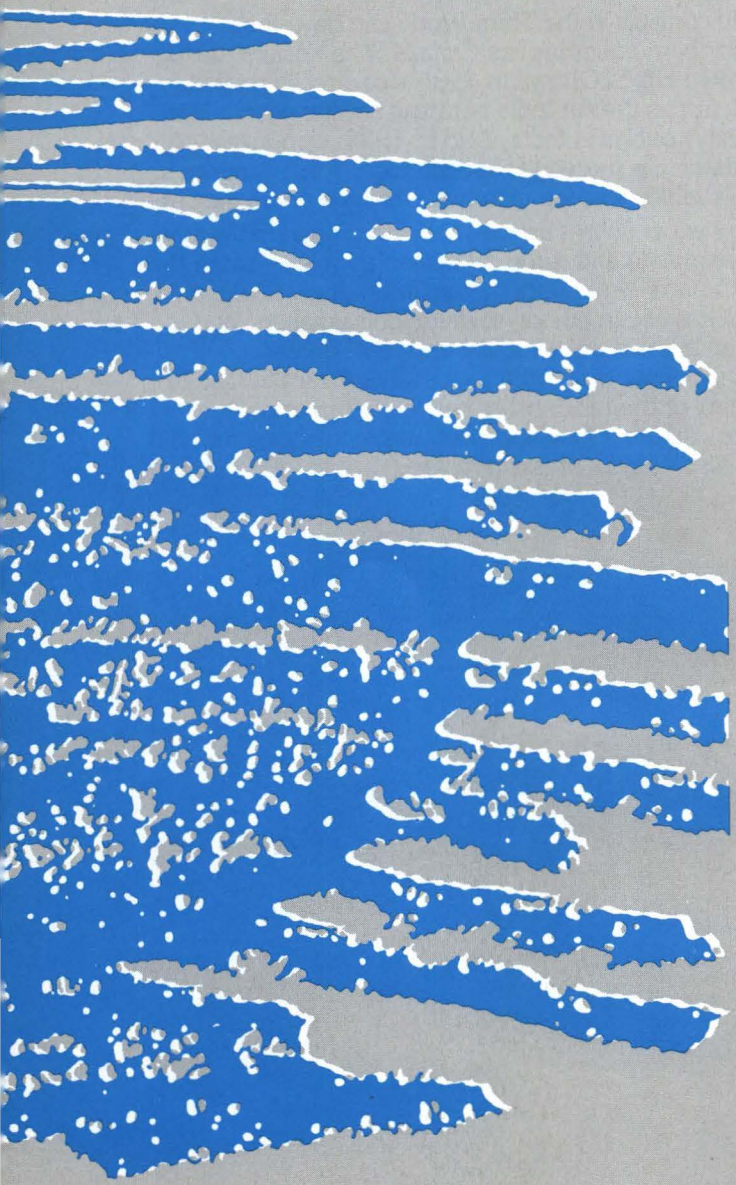
The United States and the Soviet Union are the major arms suppliers to the Third World, and foreign arms sales make up an important part of their overseas exports, with Middle Eastern countries receiving two-thirds of all weapons. The US has supplied 130 nations with weapons since 1970. France is the next major arms exporter. The production and export of weapons, however, is also becoming a structural part of the economy of certain Third World nations, especially Argentina, Brazil, China, and India. A new study reports that Chinese arms sales to the Third World exceeded those of Britain, Italy, and West Germany combined in 1985–88.

With the winding down of the Cold War, there are likely to be fewer Third World hostilities in which the superpowers are proxy

protagonists and more conflicts arising from shortages of essential resources such as water. Water shortages are developing or becoming a threat in many areas; during the 1980s, 40 nations were involved in some version of a water dispute. In the Middle East, water is expected to become an even more important source of conflict than oil when the demands for water from the Jordan and Tigris rivers exceed their capacity to meet these demands. In 1989, tensions over new land opened to irrigation led to hostilities between Mauritania and Senegal.

Even localized conflicts in the Third World can have their repercussions in Northern countries like Canada. The hostage-taking incident on Parliament Hill in Ottawa in 1989 was directly related to events in Lebanon, just as the Air India bombing several years earlier sprang from the Sikh troubles in India. Also in 1989, opponents of Chile's military dictatorship succeeded in disrupting North America's fruit markets when cyanide was found in two imported green grapes.

Global military expenditures are currently running at more than US $1.7 million per minute and some 29 million people — more than the population of Canada — are under arms. In Southeast Asia, an interesting dialogue has begun among soldiers, policymakers, and academics interested in the developmental impact of defence expenditures. This dialogue, supported by IDRC, is meant to lead to greater understanding of the relationship between arms and development and to explore a new approach to security, one more in keeping with the Third World's pressing realities.



# *The South's Scientific Contribution*

## *Part of the solution*

As we have just seen in the first part of this document, developing countries, like their industrialized counterparts, are an integral component of world problems. But they are also part of the solution.

They have a front-line role to play in reducing overpopulation, unemployment, illiteracy, injustice, and the misery that exacerbates the tensions that are the sources of conflicts. The policies adopted by governments will be major factors in determining whether these problems persist. To choose the best policies, decision-makers will need researchers in the fields of sociology, economics, health, agronomy, engineering, and the environment. The scientific and technical advances of Northern countries will also have a contribution to make. Northern laboratories have several years' head start in finding a substitute for fluorocarbons, but in the areas of health, agriculture, energy, and even economics, Southern innovations can benefit "advanced" societies. Thus, the scientific South participates as much as the North in solving world problems, and has done so for some time.

## *Explorer scientists*

During the century when the Venetian Marco Polo was discovering the marvels of the Asian world, the best minds in Europe had only to visit Toledo or Cordoba to discover some of the finest Arab universities of the time. The Pakistani physicist Abdus Salam, a Nobel laureate in 1979, enjoys reminding his audiences of the scientific predominance exercised by the Arab and Asian world for most of the Middle Ages. In Arabized Spain, young people from Europe and the Middle East came to learn algebra (an Arab invention) and the importance of zero (an Indian invention transmitted to Europe by the Arabs) from the greatest intellectuals of the era. When the construction of a bridge or cathedral posed particular problems, a call went out for the technical assistance of Arab engineers. But Abdus Salam no longer harbours any illusions: the flame of scientific creativity has been passed to the West.

All the engineers and scientists from Africa, Latin America, and Asia together represent only 10% of the 4 million researchers in the world. Only 14 of them (three in chemistry, seven in physics, and four in medicine) have won Nobel prizes, most of them for work carried out in the United States or Britain. An analysis of the major scientific reviews indicates that developing countries contribute only 5% of the world's scientific production. Some sources dispute this conclusion.

They note that many researchers in developing countries prefer to publish locally, rather than in international reviews. This is particularly true in the fields of pedology (soil sciences) and agriculture, where researchers in developing countries publish 10% of the world literature, according to the Institut français de recherche scientifique pour le développement en coopération. In the specific case of bovine reproduction in the tropics, for example, as much as 90% of all scientific production originates in developing countries.

The director of the science, technology, and development program at the Institut français defines two major areas of scientific activity to which the Third World contributes. These are world science, found in 3 000 major international scientific reviews, and local, self-directed science, which is supported by national reviews and low-distribution "grey" literature.

When all the scientific production of researchers in developing countries is considered, significant proportions (as many as 60% in Asia) publish in local journals. Those who do so are primarily young researchers working in the fields of animal and vegetable production, tree-growing, and aquaculture. This focus on local ecosystems appears to be completely logical, because species and environmental conditions are, broadly speaking, ecosystem-specific.

## *Listening to the South*

Stating that Third World scientists supply only 5% of all scientific production ignores their contribution to the knowledge of tropical ecosystems. This knowledge is becoming an increasingly important factor in world biological production and in the development of agriculture that respects the environment.

Moreover, when a question of discovering natural substances produced by the development of tropical plants is involved, the North quickly begins to listen to the South. The interest is obvious. The Amazonian forest alone maintains more species than any other ecosystem on the planet: 80 000 plant species and 30 million animal species. More than one-quarter of our medications are plant-based: tropical plants have produced tranquilizers, blood-pressure reducers, and the raw material for the first generations of contraceptives. Unlike their colleagues in agriculture and food, natural substance specialists in developing countries publish more in foreign reviews than in local ones. They also associate more with researchers in industrialized countries. With respect to natural substances, North and South cooperate well.

Recently, Australian, Belgian, British, and Japanese teams have confirmed the existence of a family of alkaloids, extracted from beans and tropical trees, that have the potential to combat diabetes, cancer, and AIDS. For their part, IDRC-supported Ethiopian physicians won the 1989 alternate Nobel prize awarded by the Swedish association Right Livelihood for demonstrating that the fruit of a local plant, the endod, contains substances fatal to snails, which are vectors of the

bilharziosis parasite; this disease affects more than 200 million people. In neighbouring Egypt, Dr M.M. El-Sawy, who also receives IDRC funding, has demonstrated a similar effect with another plant, the damsissa. If it is necessary to do so, these two discoveries again demonstrate the potential of tropical plants and Southern researchers.

## *In sickness and in health*

The drama of the 6 million people afflicted with AIDS has renewed interest in viral illnesses. Not only is an attempt being made to understand the viruses themselves more clearly, but there is also interest in their origin. Although the industrialized countries' new interest in tropical viruses is still basically self-centred, it can lead to a very useful strengthening of the research capabilities of developing countries, where rich and poor will both benefit.

According to the prestigious Commission on Health Research for Development, headed by John Evans, President of the Canadian corporation Allelix and IDRC Governor Gelia Castillo, a professor of rural sociology at the University of the Philippines, it is now a matter of priority that every developing country have a basic health research capability. This local competence is the only way for a country to obtain an accurate picture of its population's actual sanitary conditions. In this way, instead of having unrealistic policies dictated by foreign organizations or experts, a country could identify its health priorities and design policies truly adapted to its requirements. With their national roots, national experts would be in a better position to adapt policies and programs to local priority needs.

Only 4% of the money earmarked for health research throughout the world is spent in developing countries. The neglect of this enormous innovative potential is as detrimental to the South as it is to the North. A number of innovative experiments in developing countries have already shown how to design care systems that meet the needs of the majority equitably, without ruining the governments. The most celebrated is still the demonstration in the Indian state of Tamil Nadu in the early 1960s that tuberculosis patients cared for at home healed as well as those cared for in a sanitorium, without increasing the risks of infection to those around them. This dealt a death blow to the sanitorium industry; the Third World could not afford to maintain such facilities, the industrialized countries closed them, and billions of dollars were saved.

In Third World regions where medical research has literally been shackled to reality, new organizational methods have been developed. Irresistibly, care systems in the industrialized countries have been strongly influenced. A number of concepts originating in the South or first tested there (listing of essential medications, health programs with deadlines and specific objectives, and simplified instrumentation and operating techniques) are now part of Northern health policies. Ironically, the limited means of developing countries have saved them

from establishing excessively onerous and uncontrollably costly care systems.

Wealthy countries are only beginning to be inspired by health programs in poor countries; given escalating health costs, they have no choice. In countries where the government cannot fund dispensary operations, various cost-recovery formulas have been tested. In the near future, wealthy countries may be using these to replenish their health budgets. Physicians in the North will soon have in their offices a new range of diagnostic tools that are inexpensive, easy to use, and storable at room temperature. These tools have been developed to respond to constraints in countries with limited resources, no specialized staff, and limited, operating refrigeration equipment. IDRC is funding the development of a number of diagnostic kits, including some designed to detect AIDS. In the medium and long term, these new techniques will enable physicians to offer more in-office services and reduce health care costs.

In other fields, Third World scientists are also assuming leadership in the technology involved with manual water pumps and water-quality testing and asserting themselves in biotechnologies. In this context, IDRC helped Brazil master genetic engineering techniques to manufacture an excellent vaccine against yellow fever; this vaccine is now being distributed in Africa. IDRC also made a significant contribution to the work of Prof. G.P. Talwar, who, in the early 1970s, was one of the first to demonstrate the potential of a contraceptive vaccine.

Today, in large part thanks to his work, the National Institute of Immunology in New Delhi is one of the most renowned immunology research centres in the world. A contraceptive vaccine is undergoing clinical testing in several countries. In the 1990s, women all over the world will very probably be able to avail themselves of this revolutionary new contraceptive method. Because India's National Institute of Immunology remains one of the few centres still researching contraceptive methods, it is highly likely that the new, more advanced contraceptive methods needed by couples everywhere will be produced, primarily or for the most part, by research carried out in developing countries by scientists from those countries.

## *The economic laboratory*

The Third World is a laboratory for health innovation. It is also the site of economic experiments that bring certain realities to the attention of those who have become accustomed to economic progress; these experiments are also of great interest to Eastern European countries on the brink of reorganizing their economies.

Because they cannot afford poor-quality economic policies, developing countries are powerful detectors of the weaknesses of such policies. In a wealthy country, it takes years for the ravages of disastrous economic intervention to become unbearable; in a poor

country, it frequently takes only a few months for capital to flee, the inflation rate to escalate, and currency values to go into free fall.

Just as postwar Europe provided an enormous laboratory for political scientists and economists, the Third World has supplied a new area of application for social scientists. Like Europeans after the war, the residents of developing countries are far from passive subjects in this vast experiment. Finally, it is impossible to differentiate between Northern and Southern theoretical contribution. This is particularly true in the field of economic policy.

Although little more than 30 years ago, the economic situation in most developing countries was more or less identical, many of these countries are now full participants in the industrialized world. Each country must develop its own strategy, but the newly industrialized countries in Southeast Asia, among others, have some lessons to teach. The first, according to an article in *The Economist*, confirms the superiority of strategies promoting export industries over policies supporting industries that produce import substitutes. The second demonstrates that government interventions must be limited, and, the third, which is closely related to the second, requires abstention from price controls.

Thirty years of economic experiments later, Third World residents are finally realizing that there are limitations on government ability to engender economic progress directly. Instead, governments must restrict themselves to creating infrastructures and conditions favourable to the development of economic initiatives. Nevertheless, the governments of several newly industrialized countries, South Korea and Singapore, for example, have favoured their entrepreneurs in the context of very detailed plans. Although the small, import-substitution businesses set up in South Korea in the 1950s and 1960s did not bring prosperity to that country, these industries subsequently formed a useful base for the future success of industrialization by export.

Finally, another lesson, more psychological than economic, emphasizes the importance of making government action, whatever it might be, appear to be the result of internal rather than external thought and will. Bolivia is the best example of a country experiencing economic recovery after its population accepted sacrifices as a result of steps taken by the government, because the program was not imposed from the outside.

Moreover, IDRC-funded economic research, whether it involves a network researching strategies for the negotiation of national debt in Latin America or a network researching macroeconomic analysis in Africa, is designed to strengthen rigorous, original, and independent economic thought.

Given the current rebuilding of Eastern Europe, the experience of young developing countries is of great interest to their older counterparts, to the extent that economists with experience in Bolivia are proposing to apply their strategies to countries with three times the gross per-capita national product, such as Poland.

## *Brazil's lead*

Another instructive area in developing countries is energy. The US is seriously considering following Brazil's lead: beginning in 1997, Brazil will manufacture alcohol-powered vehicles. The Americans can no longer depend on imported oil, and they are attempting to reduce the pollution caused by automobiles. Replacing gasoline with methanol or ethanol seems to be a solution. Thanks to the vast experience accumulated by Brazil in the 15 years that ethanol-powered vehicles have been manufactured there, any new strategy to promote alcohol-based gasohol, which is manufactured from sugarcane in Brazil and from corn in the US, should more readily predict the difficulties inherent in these fuels. For example, the Brazilians already know that ethanol is much more costly to produce than gasoline. They are also aware of the difficulties involved in the conversion of crop materials into fuels.

A number of other experiments in developing countries, involving solar energy, biomass recycling, and hydroelectric microplants (China), are of interest to industrialized countries. Once again, financial and environmental constraints compel the Third World to invent energy facilities that the industrialized countries will subsequently adopt.

## *The world biological laboratory*

Although world commerce in grain attracts attention, trade in varieties, genetic material, and techniques is shaping tomorrow's agriculture. The US, long a dominant agricultural power, has recently become a net importer of new agricultural varieties and techniques. William Furtick, Agency Director, Directorate for Food and Agriculture at the United States Agency for International Development (USAID), fears that the US may cut itself off from Third World agricultural contributions. He stresses that unless his country invests US $175 million annually in agricultural research in cooperation with developing countries, American agriculture will be increasingly less competitive.

It is well known that almost all the plants we eat originated in the Mediterranean Basin or in areas now referred to as the Third World. After World War II, the industrialized countries repaid part of their debt by funding the international agricultural research centres (IARCs) of the Consultive Group on International Agricultural Research (CGIAR), the most famous of which are the International Rice Research Institute (IRRI) in the Philippines and the International Centre for Maize and Wheat Improvement (CIMMYT) in Mexico.

IRRI's high-yield rice and CIMMYT's corn and wheat were the basis of the "green revolution." They were developed by applying advanced techniques to existing varieties in developing countries. For example, IRRI's first high-yield rice was the result of a cross between a Japanese dwarf variety and an Indonesian variety. Today, the IARCs are the guardians of information and genetic material on the 138 plants that are essential to the world's diet.

These centres play a large part in getting developing and industrialized countries together to improve the planet's crop productions. Initially, their staff members were primarily Northern experts; now, they can count on the work of scores of Southern specialists. Indeed, the future contribution of the IARCs will depend to a large extent on their ability to associate themselves with local institutions and programs, which are more likely to give local residents the results of agricultural research.

Southern researchers have increasing numbers of successes to their credit. For example, Brazilian researchers have developed high-yield corn varieties adapted to the vast, acid-soil savannas in Africa, Asia, and Latin America. These new varieties will permit the cultivation of large areas previously excluded from agriculture. It was also Southern breeders at CIMMYT who developed new protein-rich corn varieties that promise to give this grain a new career, in much more diversified environments than wheat and rice. As countries such as China, Brazil, and India increase their food production, they contribute more to world agricultural research. This is now a tightly knit network where all the countries are interdependent.

## *Sustainable agroforestry*

Agroforestry describes agricultural systems in which shrubs and trees are grown together with food or cash crops on the same piece of land; they frequently also include livestock. Such systems can be highly productive and sustainable. Besides producing food crops, agroforestry supplies farmers with fuelwood, fruits, and fodder for animals. Trees can be used to supply poles for fencing, and their leaves can be used for mulch. Their roots draw nutrients from deep in the soil, but leguminous trees themselves are a source of soil nitrogen to fertilize the food crops. Trees and shrubs may also serve as windbreaks and natural fences.

IDRC was one of the first institutions to recognize the need to pursue research in agroforestry. A study led by the late Canadian forestry entrepreneur John G. Bene, a former IDRC governor, began a chain of events that led to the formation in 1977 of the International Council for Research in Agroforestry (ICRAF), with IDRC serving as the executing agency of its establishment and as one of its major donors since then.

An agroforestry alternative, whose development was supported by IDRC from the very beginning, is alley cropping, which consists of growing crops between rows of frequently pruned leguminous trees. Rows of shrubs spaced 3 or 4 metres apart form alleys or corridors in which grow several kinds of food crops such as maize, yams, melons, rice, and cowpeas.

Alley cropping can maintain crop yields at moderate levels without fertilizer. The prunings can be used as feed for small ruminants, such as sheep and goats, which in turn make an important contribution to the human diet.

## *A Canadian connection*

Canada, the second largest world producer of canola, from which the vegetable oil with the lowest rate of saturated fatty acids is derived, is concerned to maintain its links with the Third World. With the incorporation of genetic material obtained from China, as part of an IDRC-funded research project, Canadian breeders have just produced canola varieties that are resistant to the major illness affecting this plant.

IDRC also funds a number of joint Chinese–Canadian aquacultural research projects. These give the Chinese access to more advanced techniques and the Canadians experience in very large-scale experiments. After 5 years of collaborative research, the Vancouver-based Syndel company has marketed a breeder fish spawning kit.

This kit is the result of a joint project carried out by researchers at the University of Alberta and the University of Zhongshan in Guangzhou. Canadian fish-breeders use the kit for trout and salmon; their Chinese counterparts use the same technique for several species of carp. Another significant IDRC-funded program was designed to allow other countries to have access to maricultural research in China, encompassing the integrated breeding and raising of algae, mollusks, and fish, an area in which China's experience is unique.

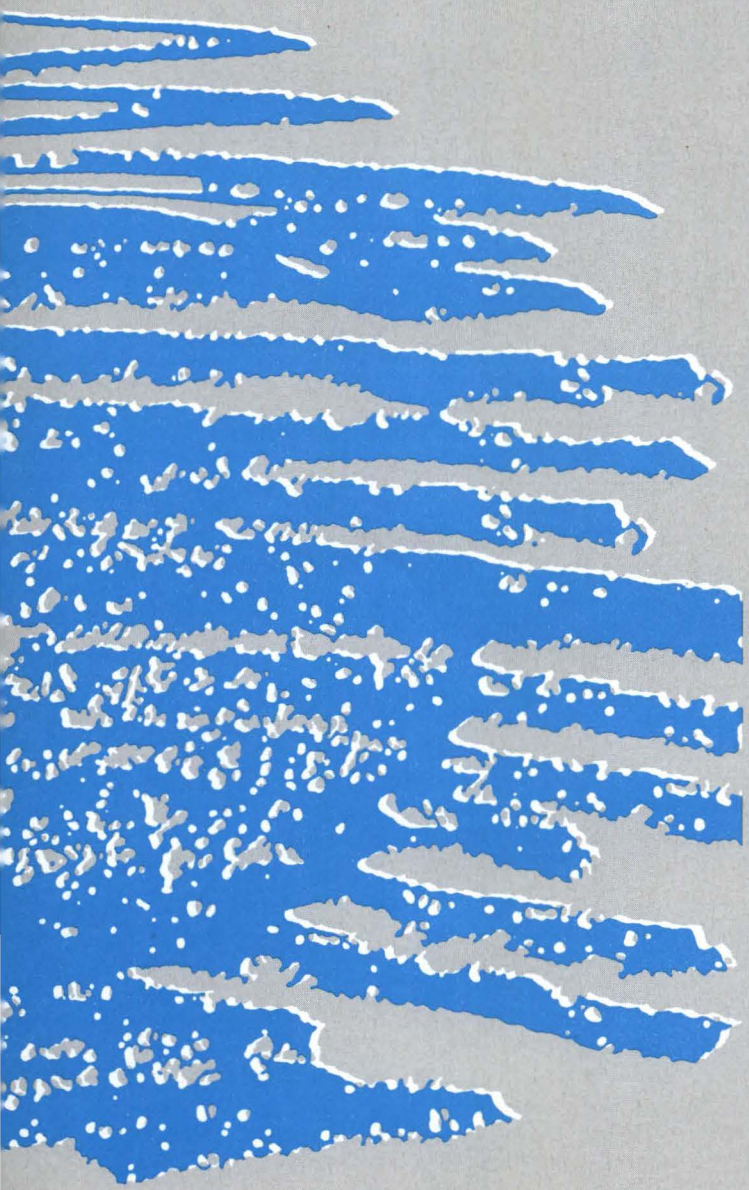
In Thailand, researchers from Dalhousie University in Halifax have been teaching how to determine the growth rate of tilapias by examining their shells; in return, they have learned new methods that permit accelerated experiments in selecting rapidly growing fish. The Thai researchers make up one of five teams in as many countries, whose work is coordinated by Canadian researchers with IDRC funding.

In the industrialized countries, opposition to the use of pesticides is increasing daily. In the developing countries, farmers can simply not afford them. Some of the most ambitious experiments in the use of natural agents to combat crop pests are taking place in Africa, Asia, and Latin America.

The most extensive biological pesticide program in the world is under way in Africa. It involves the distribution of a minuscule wasp whose larvae eat a caterpillar that was in the process of annihilating the cassava crop. Twenty-seven countries are infested, and the wasp has halved losses in several of the 20 countries in which it has been released. In Egypt, Indonesia, and Peru, other integrated experiments minimizing pesticide use will help refine techniques that will benefit farmers everywhere.

At the beginning of this year, researchers from the University of Guelph announced an agreement to work with an international chemical company to look into the marketing potential of a new biological weapon against the spruce budworm, one of the worst pests in Canada. Over the past 2 years, Canadian researchers have successfully limited budworm infestations in portions of Ontario forests. They are using the trichogram, a small wasp whose larvae devour

budworms. For many years now, with support from IDRC, researchers from Guelph have exchanged information on the trichogram with colleagues in China. The trichogram is already being used in China on a large scale to combat the corn borer. Chinese experts have developed various mass-production techniques using trichogram eggs. IDRC is also funding other research linking scientists at the universities of Ottawa and British Columbia with colleagues in Thailand to discover natural insecticides in tropical plants and trees.



# *Support for Southern Scientists*

## *Supporting each other*

In the long term, one of the best ways of helping developing countries is to strengthen their scientific and technical potential. Not only is a solid scientific and technical base necessary to eliminate underdevelopment, but also humanity as a whole cannot afford to neglect the innovative contribution of most of the intellectual talent in the world.

A country's scientific and technical stall can only be overcome by a sustained effort and by making difficult choices. Although industrialized and developing countries devote about the same percentage (between 5 and 6%) of their GNP to military expenditures, they devote only 2.5 and 0.2%, respectively, to research and development (R&D). The 134 developing countries represent four-fifths of the world's population, but these countries have produced only one-tenth of the 4 million scientists and engineers active in R&D.

Too often, the assumption of power by military regimes has brought with it the actual destruction of institutions, and sometimes people, dedicated to scientific research. Such was the case in Argentina, Ethiopia, and Uganda, although Argentina has already produced as many Nobel laureates in science and medicine as Canada.

Military conflicts and violent political change have devastated Iran's and Lebanon's scientific and technical capabilities. Moreover, the limited range of available resources and small population make long-term investment decisions still more difficult. The 67 countries with populations of less than 10 million — 52 of which have fewer than 5 million inhabitants — invest on average only 0.1% of their GNP in R&D. Without one's own research capability, it is difficult to understand and assimilate the results of research carried out elsewhere.

## *Knowledge sharing*

Scientific progress is above all an immense sharing of knowledge. What is good for the individual progress of each country, is now proving to be crucial for the future of the planet. In a growing number of fields (agriculture, energy, health, economics, and the environment), cooperation between Northern and Southern scientists is indispensable. Indeed, Southern countries are now refusing to be excluded or to remain passive in the area of planetary scientific studies, be they oceanic or climatic. Not so long ago, the major world meteorological programs were content to appoint a few Third World scientists to their

boards, pro forma, or to set up Third World observation stations completely managed from the outside. Not only does this attitude belong to another era, but also it has two major disadvantages: it deprives research programs of the increasing skills to be found in developing countries, and it prevents Southern decision-makers from relying on local sources that are well-informed on the most recent research.

The debate on the causes of and solutions to global warming will become increasingly tense and acrimonious. No consensus will be possible unless the developing countries have their own experts on the climatic effect of deforestation; the effect of thermoactive gases, such as carbon dioxide and methane; and the impact of fluorocarbons on the ozone layer.

The developing countries have a crucial need for scientists, engineers, researchers, and technologists. The most advanced countries also need these people, first to reach a consensus on world problems, then to find solutions. When the Brazilian government denies French scientists the right to study the Amazonian forest, or Ethiopia stops the collection of wild varieties of trees by foreign experts, everyone loses. On the other hand, it is very easy to understand the frustration of Brazil and Ethiopia, if they do not have their own experts capable of working together with foreign researchers and assimilating the results of their work.

## *New scientific countries*

In 1984, according to a study carried out for IDRC, the entire body of research in developing countries received external aid in the amount of $1.5–1.6 billion. The study stressed the difficulty of obtaining specific data on the R&D expenditures of a great many countries, but it concluded that external aid represented at least 10% of all research budgets, this percentage varying considerably from country to country. In African countries in fact, IDRC funding is sometimes a critical factor preventing a significant proportion of scientists in certain fields from leaving their country.

Although direct funding of research activities in developing countries remains one of the best ways of helping these countries develop, the proportion of research activities completely supported by the countries themselves has proved to be more important by far. National programs and experts are also the most likely to identify priorities and find practical solutions. That is why donors — IDRC a leader among them — now stress that support be given to national researchers and research centres.

Brazil, China, India, Mexico, and South Korea — with Brazil now having a score of biotechnology research centres — head the countries newly endowed with their own scientific and technical skills. The governments of sub-Saharan Africa, which invest only 0.4% of their GNP in research, also realize its importance. They devoted long

chapters to it in the 1980 Lagos Action Plan. Then, in 1987, they permitted the creation of the Pan-African Union of Science and Technology, which was designed to provide recognition of the African researcher and to foster improved Pan-African scientific cooperation.

## *The North–South scientific network*

The first concerted efforts to support the research activity of developing countries consisted primarily of creating the international research centres, most of them in developing countries. Whereas there were only 2 or 3 of these centres with a regional or international vocation at the end of World War II, there are now some 200 centres conducting research or supporting research activities. The CGIAR network of IARCs is the best known example. The Group now has 13 freestanding centres, and the same number more or less closely affiliated with it. Although proposals for the establishment of new centres continue to flow in to donors, the consensus is rather that national institutions should be strengthened and linked in networks.

For its part, IDRC has preferred to be associated with the establishment of strongly decentralized networks. The International Network for the Improvement of Banana and Plantain (INIBAP), whose establishment IDRC coordinated in 1985 at the request of a consortium of international donors, is the first agricultural research network consisting of four regional subnetworks linked by a director supported by a very small staff. At the same time, IDRC has always given priority to national research institutions, by strengthening their staff and programs and helping them to collaborate with other institutions and agencies, thus making them bridgeheads for national and international networks.

Today, IDRC is funding networks linking Southern scientists together with their Northern colleagues in scores of fields, from economics to industrial chemistry, and including research on refugees, breeding, hydrogeology, and water-quality analysis. IDRC also facilitates access to information by funding specialized computer networks in areas of primary importance to developing countries: agriculture, health, water, and social sciences.

Every time the opportunity arises, IDRC stresses that international organizations and forums should give more place to developing countries. When it organized the V International AIDS Conference in Montreal last June, IDRC arranged for unprecedented participation by scientists, physicians, and journalists from the Third World. It also insisted that developing countries obtain fair representation on a number of international commissions of inquiry, including the Commission on Health Research for Development and the Human Dimension of Global Change Programme, the latter being the social sciences counterpart of the International Geosphere–Biosphere Programme.

While exercising its influence in significant international circles, IDRC continues to seek the best ways of making scientific and technical

progress accessible to the most disadvantaged residents of Africa, Asia, and Latin America. After funding more than 4 000 research projects in about 100 countries, IDRC has noted the importance of the choice of scientists and institutions. In analyzing the distribution and use of hundreds of research projects, IDRC experts have concluded that priority must be given to researchers and institutions that are truly linked to user requirements. Occasionally, the dynamism with which an individual scientist has communicated his or her work has made all the difference and has enabled communities to benefit concretely from the results of research.

In association with the Canadian International Development Agency (CIDA), IDRC has also cooperated with a growing number of nongovernmental organizations (NGOs), particularly those established on site, such as the Bharatiya Agro-Industries Foundation (BAIF) in Puna, India. BAIF was founded by disciples of Mahatma Gandhi and has unique experience in collaborating with the rural Indian community; the IDRC pilot project will equip this NGO with its own research capacity.

IDRC's confidence in a Sri Lankan NGO 10 years ago clearly demonstrates the immense potential of organizations that are really concerned about those around them. The Lanka Jathika Sarvodaya Sangamaya is undoubtedly one of the most renowned NGOs in the world. After creating its own research institute, the Sarvodaya Movement obtained IDRC support to develop and manufacture a water pump. All the manufacturing work was handled by women, and the project is such a success that the Sarvodaya pump is the best in Sri Lanka, to the extent that the government has asked the Movement to manufacture all the pumps it needs for the entire country.

In carrying out its mandate, IDRC first hoped to help populations in developing countries. IDRC now realizes that it is ultimately at the service of all humanity, be it in the South or North. As one of the awards it has received states: "Its perceptive, imaginative, and generous modus operandi has profound implications for the stability and well-being of the interdependent world of the 21st Century."

Even in Canada, the government has recognized the absolute necessity of fostering links between Canadian scientists by funding a series of networks of excellence associating universities and businesses. For years, IDRC has supported the international activities of certain members of these networks, including research into concrete, useful biotechnologies in the fight against harmful insects and validation of ocean resources. Because IDRC has extensive experience in supporting research networks, it is well placed to measure the validity of this approach. In IDRC, Canada has a suitable tool, not only for fostering the Third World's contribution to solving its own and the world's problems, but also for maintaining dialogues with the most brilliant minds in the developing countries.

In continuing to fund IDRC, the Canadian government is making a unique contribution to international development; it is also fostering increasingly beneficial exchanges between scientists in a country with 25 million inhabitants and those in countries with a cumulative

population of 4 billion. By cutting its international aid budget, and consequently IDRC's, Canada is decreasing its exchanges with African, Asian, and Latin American scientists whose contributions will be increasingly decisive. This is only one example of the way in which significant cuts in the international development budget affect Canadians as well as the world's disadvantaged people. On the other hand, by increasing their support of scientists in developing countries, Canadians are fostering the advent of a world where science and technology will be used everywhere to solve global problems.

## *What do Canadians think ?*

In December 1988, the Decima research firm in Toronto contacted 1 000 Canadians by telephone to solicit their opinions on international aid policies. Decima posed 54 questions. Among them were: What is the most important global problem? Response: the environment. Do the problems of developing countries have an impact on Canada? Response: 25% felt the impact was considerable; half believed there was some impact. Do you think scientists in developing countries can help solve their countries' problems? Response: nearly 40% thought their contribution was significant; nearly 50% felt it was useful.

When asked to choose between various ways of supporting developing countries, the vast majority opted for providing the resources and skills required for self-development. Of the Canadians questioned, 85% believe that the best kind of priority aid is support for scientific research in developing countries. In their opinion, research aid is even more important than technical assistance to farmers and businesspeople.

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The *Searching Series* is intended for an informed public concerned with the broad questions of international development. The opinions expressed are meant to inform and encourage interest in the issues related to research and development. In an effort to understand our developing world better, *Searching* examines the common challenges that face both North and South.


Searching Series 1